Jam Jar Jet

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TOOLS:

- Cookie sheet (1)
- Drill (1)
- File (1)
  or sandpaper
- Gloves (1)
- Refrigerator (1)
- Safety glasses (1)
- Teaspoon (1)
- Wire cutters (1)

PARTS:

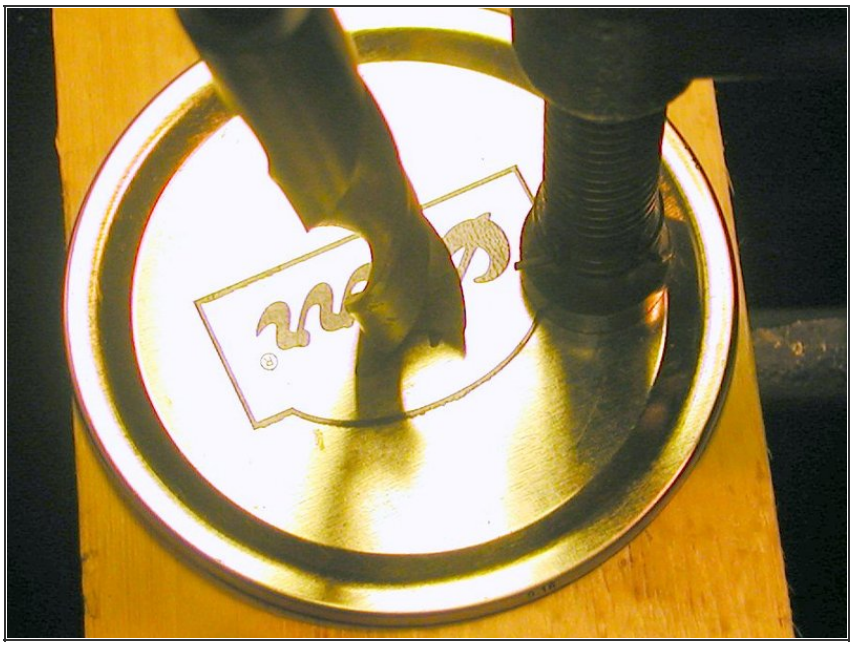
- Mason jar (1)
- Magnet wire (1)
- DWV reducing fitting (1)
  These two pipe fittings are for the conical air diffuser.
- Methanol gasoline treatment (small bottle)
  Available at auto supply stores as gas-line antifreeze; common brands include Heet and Pyroil.
- Matches (1 package)
  or a long-handled barbeque lighter
- Table salt (1)
  optional
- Plastic pipe (1)
  or metal; optional
- Boric acid crystals (1)
  optional

SUMMARY

Turbojets and fanjets contain hundreds of rotating parts. But the ancestors of these designs, called pulsejets, convert fuel and air into propulsive force by using a fixed geometry of chambers and ducts, with no moving parts. The simplest pulsejet is the Reynst combustor, which uses one opening for both air intake and exhaust. The pioneering Swiss jet engineer Francois Reynst discovered this combustor as a pyromaniac child. He perforated the lid of a

glass jar, put a small amount of alcohol inside, and lit the top. Flames shot out of the hole and then were sucked back into the bottle before being ejected again. This almost-magical process repeated until all of the fuel was expended. Reynst had discovered a jar that literally breathed fire, like St. George's dragon. Our jam jar jet is based on Reynst's discovery.

Step 1 — Drill the port.



- Drill a ½" diameter hole

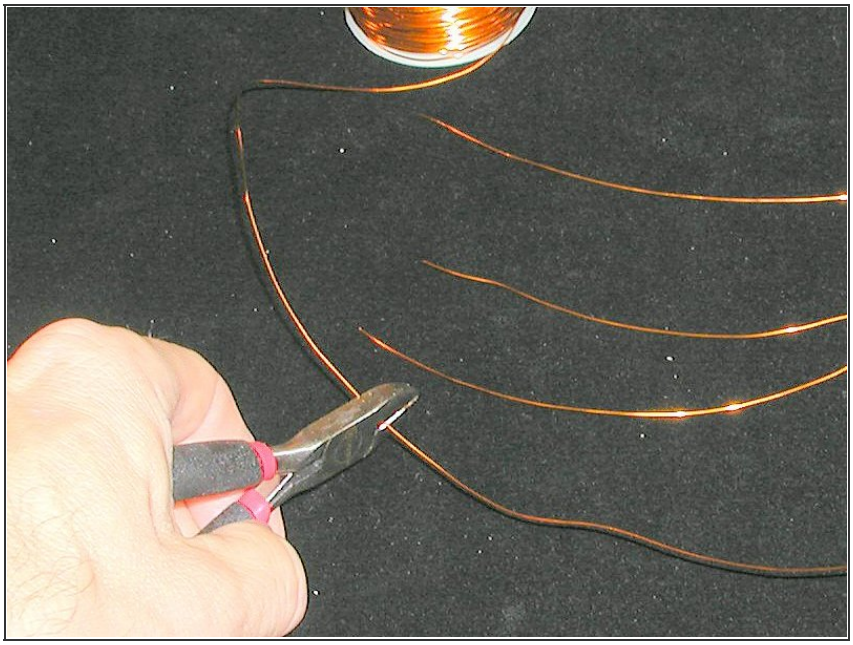
Step 2 — Drill the diffuser holes.

- Drill four 1/8" diameter holes in the small copper adapter. The holes should be located about ¼" down from the smaller, 1" diameter end. Space the holes evenly around the perimeter at 90, 180, and 270 degrees from the first hole.

Step 3 — Assemble the diffuser.

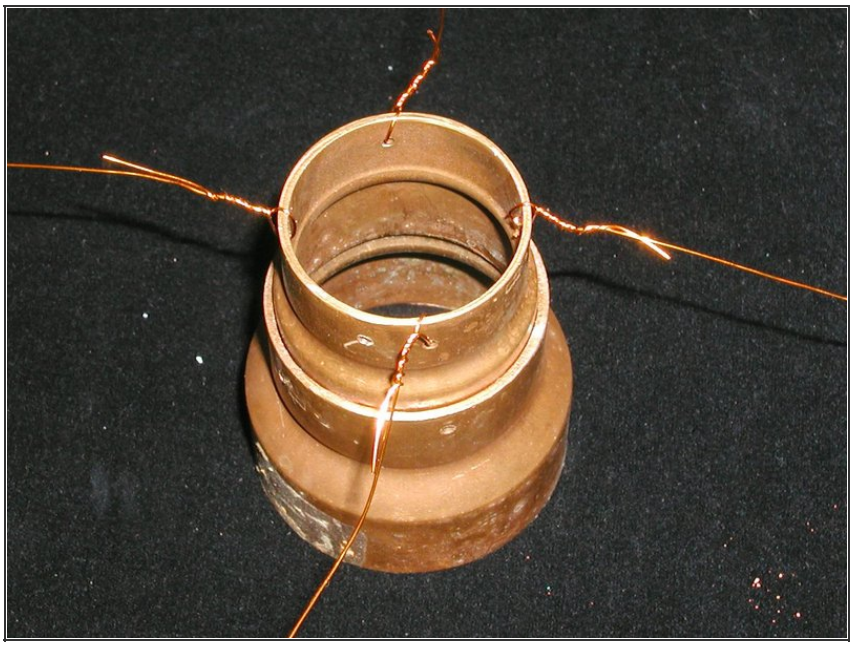
- Insert the large end of the small copper adapter into the small end of the large copper adapter. Press-fit them together firmly. This forms the conically shaped jet diffuser and heat sink.

Step 4 — Cut the diffuser wires.



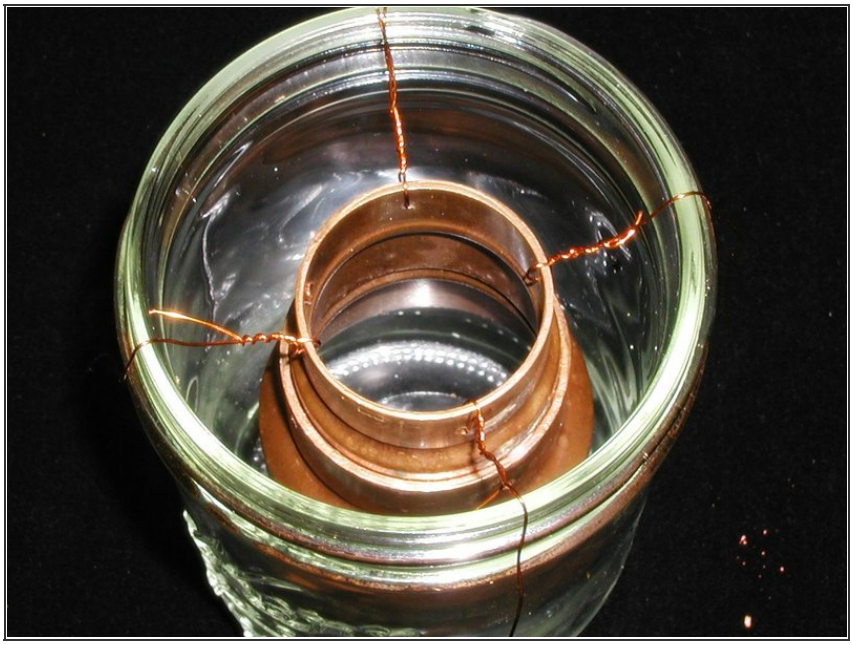
- Cut four 4" long wires from the spool of magnet wire.

Step 5 — Attach the wires.



- Loop one wire through each one of the holes you just drilled, and tie a knot. Extend the other end of the wires outward, radially, from the diffuser cone.

Step 6 — Suspend the diffuser.



- Center the copper diffuser in the middle of the jar. Crimp the wires over the edge of the jar so that the cone hangs suspended close to the top of the jar, with a gap of about ¼" between the diffuser and the top.

Step 7 — Add the fuel.

- Carefully pour or use an eyedropper to measure and add 5 to 10ml (roughly 1-2 teaspoons) of methanol into the bottom of the jar. You can vary the amount of methanol by a small amount to improve performance. At most, the methanol should just cover the bottom of the jar.

Step 8 — Close the jar.

- Screw the Mason jar lid down onto the jar and over the copper wires. The lid will hold the diffuser cone

Step 9 — Vaporize some of the fuel.

- Prepare the jar by letting it sit in the freezer for two minutes. Hold your thumb over the opening in the lid. Vigorously swirl and shake the methanol inside the jar. Place the jam jar jet on a cookie sheet and place the cookie sheet on a secure surface, away from any flammable objects.
- When you remove your finger from the hole, you should notice a slight pressure release, and the jar should make a very faint “pffft” sound. If you feel no slight pressure and hear no sound, shake the jar again. If there is still no pressure, there is a leak in the seal of the jar that you’ll need to fix.

Step 10 — Fire it up.

- Wearing safety glasses and gloves, hold a flame over the opening in the jar's lid.
- The fuel will ignite, and for the next 5 to 15 seconds, the jam jar jet will cycle, pulse, and buzz, running at a low but audible frequency of about 20Hz, depending on conditions in the jar and in the surrounding air. With the lights down low, you'll enjoy a noisy, deep blue pulse of flame that grows and shrinks under the lid as the jar breathes fire. It's an amazing effect.

Step 11 — Optional: Using the optional ingredients to make pint-sized fireworks.

- During the air-intake part of the cycle, the bottom of the jam jar jet glows brightly. The photo on page 102 shows the blue flame you'll get from burning straight methanol, and this photo (at right) shows the yellow variant that comes from adding a little salt to the fuel. By adding salt or boric acid crystals, you can color your flames in a variety of attractive, retina-burning hues, as described on the next page.

Step 12

- Variations: 1. For a bright yellow flame instead of the blue, add a pinch of table salt to the methanol. 2. For green-colored flame, add a pinch of boric acid crystals to the methanol. 3. To amplify the sound of the jet, hold a tube a half inch or so above the hole. You can use a metal or plastic pipe, and even the cardboard from a roll of paper towels will last a little while. Use pliers or a gloved hand to hold the tube in position. Experiment with the length and diameter of the tube. When the size is right, you'll be rewarded with an unmistakably loud, deep, resonant buzz.
- Some enthusiasts make Reynst combustors with metal jars instead of glass, and outfit them with resonator tubes permanently attached above the hole. These are sometimes termed "snorkelers." The most advanced snorkelers also have fuel-feed systems that drip methanol into the combustion chamber, which allows them to sustain combustion for long periods of time.

Step 13 — Troubleshooting

- If the methanol burns with a single big whoosh instead of pulsing: Check the size of the hole and make sure it is accurately drilled to a ½" diameter.
- Place the jar in the freezer for two minutes before lighting.Slightly cooling the fuel and the jar improves performance.
- Make certain the jar is charged with the recommended amount and type of fuel.
- If you hold the long match over the opening and it doesn't ignite, or it does ignite but the pulse is weak, make sure the methanol is fresh.
- Cool down the jar in the freezer for two minutes.
- Start with just one teaspoonful of fuel in the bottom, and vary the amount slightly until you get better performance results.
- Check the seal by listening for the "pffft" when you remove your finger from the hole. If necessary, rejigger the lid to get a good seal.

Step 14

- Reposition the diffuser by adjusting the support wires, or try shortening the diffuser by removing the bottom section.

Step 15

- If the jar cracks, carefully dispose of the broken jar and replace it with another one of the same size. The Reynst combustor/pulsejet is a very efficient burner and therefore extracts a lot of heat from the fuel very quickly. If the jar you're using cannot handle the rapid expansion, it will crack.

Step 16 — Resources

- Pulsating Combustion: The Collected Works of F.H. Reynst, Pergamon Press, 1961
- Homemade pulsejets webpage and discussion forum: http://pulse-jets.com
- Larry Cottrill's jetZILLA, an online magazine of amateur jet propulsion: http://jetzilla.com

This article first appeared in MAKE Volume 05.

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